

# Association of the *LiveLighter* mass media campaign with consumption of sugar-sweetened beverages: Cohort study

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## Abstract

**Issue addressed:** Evaluation of the behavioural impact of Western Australia's *LiveLighter* healthy weight and lifestyle campaign focussed on decreasing consumption of sugar-sweetened beverages (SSBs) using graphic imagery, as well as monitoring unintended consequences.

**Methods:** A cohort design with pre-campaign telephone survey of Western Australian adults aged 25-49 (Time 1 May/June 2013: N = 1504) undertaken and repeated following the campaign (Time 2 Aug/Sep 2013: N = 822).

**Results:** Post-campaign awareness was 67% with respondents in low socio-economic areas most likely to report viewing the campaign frequently. There was evidence of reduced SSB intake from baseline to follow-up among frequent (4+/week) SSB consumers (22% cf. 16%;  $P = 0.003$ ) and some evidence among overweight (BMI 25+) weekly SSB consumers (56% cf. 48%;  $P = 0.013$ ). There was also some evidence consumption of sweet food decreased (3+/week: 53% cf. 48%;  $P = 0.035$ ) while fruit, vegetable and fast food consumption remained stable. Knowledge of potential health consequences of SSBs increased (70% cf. 82%;  $P < 0.001$ ) with no change in knowledge of potential health consequences of overweight generally (86% cf. 89%). Importantly, there was no increase in endorsement of overweight stereotypes.

**Conclusions:** The *LiveLighter* "Sugary Drinks" campaign positively impacted adults' knowledge and behaviour with regard to SSB consumption in a pattern specific to the campaign messaging and without adverse impact on weight-related stereotypes.

**So what?** Findings support the use of mass media for healthy lifestyle change. They suggest the public are receptive to undertaking the campaign's simple concrete lifestyle recommendation and provide an indication of the campaign dose required to achieve positive behaviour change.

## KEYWORDS

Australia, health behaviours, mass media, obesity, sugar-sweetened beverages, sugary drinks

## 1 | INTRODUCTION

Sugar-sweetened beverage (SSB) consumption is one of few dietary factors causally linked with overweight and obesity.<sup>1,2</sup> As a result, SSB consumption is a critical target for obesity prevention.<sup>3</sup> In Australia and the United States, SSBs (soft drinks, energy drinks, sports drinks, fruit drinks and cordial) are the largest source of added sugar in the diet.<sup>4-8</sup> It follows that reducing SSB consumption represents an effective way to reduce sugar intake, thereby helping to prevent weight gain among the population.

The World Health Organization identified mass media as an effective tool for obesity prevention,<sup>9</sup> and public health advertisements about the health consequences of excess body weight accompanied by graphic imagery are most persuasive.<sup>10</sup> Campaigns promoting reduced SSB consumption have been implemented in several states of the United States.<sup>11-16</sup> Those consisting primarily of mass media advertising have promoted increased knowledge and intentions, while the more comprehensive campaigns where mass media advertising was accompanied by significant policy or regulatory change demonstrated impact on SSB consumption.<sup>13,16,17</sup>

In Australia, the first application of mass media designed to reduce SSB consumption was the Western Australian government-funded *LiveLighter* "Sugary Drinks" campaign, which targeted adults and was based on behavioural theory and considerable formative research.<sup>18</sup> The campaign evaluation aimed primarily to estimate the population impact of the campaign on sugary drink consumption. It also assessed knowledge and beliefs related to sugary drinks and monitored unintended consequences in terms of weight-related stereotypes, thereby contributing to the evidence and discourse on the potential utility of mass media for the promotion of healthy lifestyle changes aimed at obesity prevention.

## 2 | METHODS

### 2.1 | The campaign

The first phase of the *LiveLighter* healthy weight and lifestyle campaign detailed elsewhere,<sup>18</sup> introduced the graphic depiction of visceral fat around vital organs. Formative research was undertaken in the development of the campaign.<sup>19</sup> The second phase of the campaign comprised a television advertisement (30-second and 15-second versions) that also included this imagery and focused on the contribution of SSBs to the development of visceral "toxic fat" and ultimately disease.<sup>20</sup> The "Sugary Drinks" campaign launched in Western Australia (WA) on 19 July 2013 and ran for 6 weeks, achieving 1138 target audience rating points (TARPs) (average 190 weekly), a standard measure of television media exposure indicating reach (percentage of the target audience exposed) and frequency (number of times exposed) of campaign waves.<sup>21</sup> Therefore, 1000 TARPs might represent 100% of the target audience seeing the campaign advertising 10 times, or 50% of the target audience seeing it 20 times. Television advertising was complemented by cinema, radio, print, outdoor and digital advertising as well as a website containing

supporting resources<sup>22</sup> and the advertisements. *LiveLighter* also incorporates media advocacy and stakeholder engagement to generate community and political discussion aimed at policy and environmental change. The supporting media elements reiterated the message about the potential negative health consequences of sugary drink consumption and that their reduction would reduce the risk. This evaluation focussed on awareness and impact of the television advertisement.

### 2.2 | Evaluation design and sample

We used a cohort study design, with a telephone population survey of 1504 Western Australians aged 25 to 49 undertaken before the campaign launch (Time 1: May/June 2013) and repeated following the campaign (Time 2: Aug/Sept 2013; N = 822). The survey response rate at Time 1 was 38% and the retention rate at Time 2 was 55%. Telephone interviews were undertaken by the Social Research Centre and Edith Cowan University with random digit dialling drawn from a sample frame of private landline telephone numbers. Ethics approval was obtained from Cancer Council Victoria's Human Research Ethics Committee (HREC0018) and no incentive was provided to participate.

### 2.3 | Measures

At both time-points, respondents were asked about their knowledge and beliefs about the health effects of overweight and SSB consumption, and the question wording is given in Table 1. Similar questions were used in a subsequent evaluation.<sup>20</sup> Campaign recall and recognition were measured at only Time 2 and were summed to provide total awareness. To control for order effects, the sequence of presentation of response options by telephone interviewers was randomised.

To check for potential unintended campaign effects, respondents were asked whether they agreed or disagreed with five weight-based stereotypes. Based on factor analysis, a composite scale combined ratings of "agreed" for two or more stereotypes.<sup>18</sup> Respondents who reported they drank SSBs one or more times in the last week were classified as "weekly SSB consumers" and those who drank SSBs four or more times in the last week were classified as "frequent SSB consumers."<sup>23</sup>

### 2.4 | Statistical analysis

Data were analysed using Stata SE 14.2<sup>24</sup> and survey weights<sup>25</sup> were applied for age, sex, highest level of education, location (capital city/rest of state), parental status and main language. Chi-square analyses tested whether the samples differed between those who did and did not complete follow-up (N = 822 cf. N = 682). All subsequent analyses included only participants with complete data sets (N = 822). Multivariable logistic regression models accounting for the repeated measures design were tested using a population-average model to assess differences in knowledge, beliefs and behaviour over time. Interaction terms were added to models to determine whether change over time differed by body mass index

**TABLE 1** Outcome measures: questionnaire wording, response options and binary aggregation for analysis

Outcome	Question	Response options	Binary aggregation
<b>Campaign awareness</b>			
Recall	(a) In the past month or so, have you seen any advertisements on television about being overweight? (b) Which ad about being overweight do you most remember? Can you describe what happened in this ad? (c) Which other ads about being overweight do you remember seeing in the past month or so?	(a) Yes; No; (Don't know); (Refused); (b & c) Code mentions of the "Sugary Drink" advertisement.	Recall of "Sugary Drinks" advertisement cf. no recall of "Sugary Drinks" advertisement.
Recognition	A moderately overweight man in a convenience store who buys a sugary drink. The man grabs his gut and the camera zooms in to show his insides. The voiceover says "sugar in any sugar-sweetened beverage is sugar your body doesn't need. So it gets turned into fat, including toxic fat around your vital organs, which can lead to cancer, type 2 diabetes and heart disease." Have you seen this ad in the past month or so?	Yes; No; (Don't know); (Refused).	Recognition of "Sugary Drinks" advertisement cf. no recognition of "Sugary Drinks" advertisement.
<b>Knowledge</b>			
Knowledge of overweight and toxic fat link	Thinking about what goes on inside the body of an overweight or obese person. Based on what you know or believe, which one of these health effects does being overweight or obese cause....? (Interview note: single response only).	(Randomise) Toxic fat to build up; The blood to thicken; The heart and lungs to contract; (None); (Don't know); (Refused).	Toxic fat to build up cf. all other responses.
Knowledge of sugary drink and toxic fat link	Based on what you know or believe, which one of these health effects does drinking too many sugary drinks like soft drink cause....? (Interview note: single response only).		
<b>Beliefs</b>			
Believe health would improve with weight reduction	If you lost weight, do you think your health would... Decline a lot/a little; Improve a lot/a little?	Decline a lot; Decline a little; Neutral; Improve a little; Improve a lot; (Don't know); (Refused).	Improve cf. decline/neutral.
Overweight stereotypes	I'm now going to read out some statements that other people have made about overweight people, please tell me the extent to which you agree or disagree with the following statements. Compared to "healthy" weight people, overweight people are more likely to: (Randomise) Be happier; Lack will power; Have fewer friends; Be outgoing; Have less energy.	Strongly disagree; Somewhat disagree; Neither agree nor disagree; Somewhat agree; Strongly agree; (Don't know); (Refused).	Ratings of Somewhat/ Strongly agree for 2 or more stereotypes cf. all other responses.
<b>Behaviour</b>			
Sugary drink consumption	(a) During the past 7 days, on how many days did you drink a can, bottle or glass of a sugar-sweetened drink such as soft drinks, energy drinks, fruit drink, sports drinks and cordial? Do not include diet drinks. (Interviewer note: fruit drink does not include 100% fruit juice). IF 1 to 7: (b) On days that you did drink sugar-sweetened drinks, how many times per day did you usually drink them?	(a) Days in the past 7 drank sugary drink (Range 0-7); (Don't know); (Refused); (b) Once a day; Twice a day; 3 times per day; 4 or more times per day; (Don't know); (Refused).	1 or more times in last week classified as "weekly SSB consumers"; 4 or more times in last week classified as "frequent SSB consumers."

(Continues)

TABLE 1 (Continued)

Outcome	Question	Response options	Binary aggregation
Fruit consumption	Thinking back over the past 7 days, how many serves of fruit did you usually eat each day? A serve of fruit is equal to one medium piece, two small pieces of fruit or one cup of diced fruit.	Serves per day; None; Less than one a day; (Don't know); (Refused).	2 or more serves a day cf. all others.
Vegetable consumption	Thinking back over the past 7 days, how many serves of vegetables did you usually eat each day? A serve of vegetables is equal to half a cup of cooked vegetables or 1 cup of salad.	Serves per day; None; Less than one a day; (Don't know); (Refused).	5 or more serves a day cf. all others.
Sweet food consumption	(a) During the past 7 days, on how many days did you eat sweet foods (such as cakes, biscuits, lollies and chocolates)? IF 1 to 7: (b) On days that you did eat sweet foods, how many times per day did you usually eat it?	(a) Days in the past 7 ate sweet foods (Range 0-7); (Don't know); (Refused); (b) Once a day; Twice a day; 3 times per day; 4 or more times per day; (Don't know); (Refused).	3 or more times a week cf. all others.
Fast food consumption	(a) During the past 7 days, on how many days did you eat take-away or "fast foods" (such as fish and chips, hamburgers, fried chicken, pizza, sausage rolls, meat pies)? IF 1 to 7: (b) On days that you did eat take-away or "fast food," how many times per day did you usually eat it?	(a) Days in the past 7 ate fast food (Range 0-7); (Don't know); (Refused); (b) Once a day; Twice a day; 3 times per day; 4 or more times per day; (Don't know); (Refused).	1 or more times a week cf. all others.

(BMI). Models controlled for baseline demographics: sex, age, BMI (except where included as an interaction term), weekly SSB consumption, socio-economic position (SEP), parental status and commercial television viewing (>2 hours/day), and baseline levels of the outcome variable. Planned statistical comparisons were undertaken and a statistical significance level of  $P < 0.05$  was accepted; however findings between  $P < 0.05$  and  $P < 0.01$  are interpreted with caution to account for multiple comparisons. Multivariable logistic regression also tested whether campaign awareness varied by demographic characteristics.

### 3 | RESULTS

#### 3.1 | Respondent characteristics

Table 2 shows those who completed follow-up were more likely to be female, older (45+ years), parents and non-weekly SSB consumers. Completion of follow-up did not differ by BMI, SEP, location or television viewing time. Table 2 also shows the demographic characteristics of the final sample for analysis ( $N = 822$ ). Of these, 59% were female, 71% resided in a metropolitan area and 56% had overweight or obese BMI. A slightly greater proportion were of mid and high SEP compared to low SEP.

#### 3.2 | Awareness of the *LiveLighter* "Sugary Drinks" campaign

Twenty-eight percent of adults described *LiveLighter* "Sugary Drinks" when asked to recall television advertisements about being overweight. When recall was combined with campaign recognition, overall 67% ( $n = 528$ ) were aware of "Sugary Drinks." There was no

difference in overall awareness by demographics, SSB consumption or BMI. Among those aware of "Sugary Drinks," reports of seeing the campaign three or more times at Time 2 were more likely among low SEP adults compared with mid- and high-SEP adults (82% cf. 62% for both;  $P < 0.05$ ) and adults aged 35 to 44 years compared to those aged 25 to 34 (76% cf. 61%;  $P < 0.05$ ). There was no difference in viewing frequency by other demographic characteristics assessed.

#### 3.3 | Impact of the *LiveLighter* "Sugary Drinks" campaign on knowledge, beliefs and behaviour

Table 3 shows the proportion of respondents correctly selecting "toxic fat to build up" as a health effect of *being overweight* was high at Time 1 (86%) and did not increase significantly at Time 2 (89%), or vary over time differentially by BMI. However, the proportion correctly selecting "toxic fat to build up" as a health effect of *drinking too many sugary drinks* significantly increased from Time 1 to Time 2 (70% cf. 82%;  $P < 0.001$ ) and this increase did not significantly differ by BMI.

Around half of respondents reported consuming SSBs at least weekly at both time-points (see Table 3). However, there was a significant time by BMI interaction ( $P = 0.005$ ), whereby respondents with overweight or obesity were somewhat less likely to report drinking SSBs at this frequency at Time 2 compared to Time 1 (OR = 0.47; 0.26-0.85;  $P = 0.013$ ), while there was no difference over time among those who were not overweight in reporting this level of consumption (OR = 1.80; 0.89-3.64;  $P > 0.05$ ). Intake among frequent SSB consumers (4+/week) decreased significantly overall from Time 1 to Time 2 (22% cf. 16%;  $P = 0.003$ ) and there was some evidence of reduced consumption of sweet food (3+/week: 53% cf. 48%;  $P = 0.035$ ). These decreases did not significantly differ by BMI.

**TABLE 2** Sample characteristics by study completion status

	Completed follow-up (N = 822)	Did not complete follow-up (N = 682)
Sex <sup>a</sup>		
Male	40.9	50.3
Female	59.1	49.7
Age <sup>a</sup>		
25-34 y	31.0	39.7
35-44 y	40.4	37.0
45+ y	28.6	23.3
Body Mass Index <sup>b</sup>		
Not overweight	43.6	46.8
Overweight/obese	56.4	53.2
SSB consumption <sup>c,a</sup>		
<1 time last week	48.6	42.4
1+ times last week	51.4	57.6
Geographic location		
Metropolitan	71.4	72.6
Rural	28.6	27.4
Socio-economic position <sup>d</sup>		
Low	26.5	30.2
Mid	36.8	34.0
High	36.7	35.8
Commercial television viewing		
More than 2 h	12.4	13.1
Parental status <sup>a</sup>		
Parent	69.2	58.9

Unweighted percentages. Percentages are rounded so may not sum to 100%.

<sup>a</sup>Significant difference overall at  $P < 0.05$ .

<sup>b</sup>Weight status based on BMI (weight (kg)/ height (m)<sup>2</sup>) using self-reported height and weight. Missing data: completers  $n = 17$ , non-completers  $n = 24$ .

<sup>c</sup>Missing data: completers  $n = 1$ , non-completers  $n = 2$ .

<sup>d</sup>SEP was determined according to the Index of Relative Socio-Economic Disadvantage (IRSD) rankings for Western Australia as described by the Australian Bureau of Statistics,<sup>45,46</sup> based on respondent's home post-code. Low IRSD indicates greater disadvantage, high IRSD indicates least disadvantage. Missing data: completers  $n = 2$ , non-completers  $n = 9$ .

Respondents' stereotypical perceptions of individuals with overweight, beliefs about the health benefits of weight loss, fruit, vegetable and fast food consumption, also did not significantly differ across time-points or over time differentially by BMI.

## 4 | DISCUSSION

Measurement of proximal outcomes showed the campaign achieved a high level of awareness with 67% of adults recalling or recognising the "Sugary Drinks" campaign. Attaining adequate exposure among

a significant proportion of the target population is a prerequisite for achieving health behaviour change.<sup>26-28</sup> It has been suggested that campaigns such as *LiveLighter* could unintentionally stigmatise individuals with overweight.<sup>29-31</sup> However, we found endorsement of overweight stereotypes did not increase after the "Sugary Drinks" campaign aired. It is important that public health media campaigns promote optimal weight-related health behaviours and do not simultaneously stigmatise individuals with obesity, as weight stigmatisation contributes to negative health outcomes and behaviours that can promote and exacerbate obesity.<sup>32,33</sup> Formative research pre-testing healthy weight and lifestyle mass media campaigns with respondents of differing BMI categories are critical to ensuring this.

As a mechanism to provide motivation for lifestyle change, the campaign aimed to increase awareness and understanding of the health consequences of SSB consumption. Messages about the negative health consequences of lifestyle behaviours have been shown to provide motivation for positive change in other public health campaigns.<sup>10,34,35</sup> Given the observed increase in knowledge reflects the campaign message about the health effects of drinking too many SSBs, this provides support for the campaign as a driver of the increase. These findings also support the benefits of a specific, actionable health-message in public health communication.

Further support for a focussed health-message comes from evidence of short-term positive behaviour change which may be associated with the campaign; specifically, an absolute 6% point reduction in frequent SSB consumption among adults overall and some evidence of an 8% point reduction among adults with overweight or obesity who were weekly SSB consumers at baseline. A national trend towards reduced consumption has been observed in Australia from 49% having consumed an SSB on the day prior in 1995 to 42% in 2011-2012.<sup>36</sup> However, young children were the largest source of this reduction and no change was observed among adults aged 31 to 50 years.<sup>36</sup> This suggests the reduction observed in the present study cannot be fully accounted for by this general movement away from SSBs which is due to other socio-cultural forces.

Interestingly, the decrease in consumption here was observed among frequent consumers overall, and also among adults with overweight or obesity for less frequent (at least weekly) consumption. This is perhaps consistent with the depiction of an individual with overweight in the campaign advertising and the message about how "breaking a sugary drinks habit" can help reduce weight gain and associated health risks, suggesting the campaign may have resonated with individuals with overweight or obesity and high SSB consumers of varying weight. Also in line with the focus of the campaign advertising on sugar, some evidence of a reduction in sweet food consumption was observed while no evidence of change was seen in other unrelated behavioural measures of fast food, fruit or vegetable consumption. This could also reflect a national trend away from sugary foods due to the negative impacts of sugar on health being on the agenda in the popular media in Australia and elsewhere—for example, discussion of the introduction of a "sugar tax" and the promotion of low-sugar diets.

**TABLE 3** Survey respondents' knowledge, beliefs and behaviour related to sugar-sweetened beverages, by study phase

	Overall (N = 822)		Overweight (n = 454)		Not overweight (n = 351)		X <sup>2</sup> for interaction (time x BMI)
	Time 1 % [95% CI]	Time 2 % [95% CI]	Time 1 % [95% CI]	Time 2 % [95% CI]	Time 1 % [95% CI]	Time 2 % [95% CI]	
<b>Knowledge</b>							
Health effect of being overweight or obese	86.2 <sup>a</sup> [82.4-89.3]	88.7 [84.8-91.6]	86.6 <sup>a</sup> [81.3-90.5]	88.9 [83.4-92.8]	86.8 <sup>a</sup> [81.0-91.1]	88.6 [82.6-92.7]	0.01
Health effect of too many SSBs	69.5 <sup>a</sup> [64.6-73.9]	81.8 <sup>**</sup> [77.6-85.4]	69.7 <sup>a</sup> [63.0-75.7]	77.4 [71.0-82.8]	70.4 <sup>a</sup> [63.1-76.9]	86.8 [81.5-90.8]	2.82
<b>Beliefs</b>							
Weight loss would improve health	77.6 <sup>a</sup> [73.4-81.3]	77.5 [73.3-81.3]	92.5 <sup>a</sup> [88.6-95.2]	92.0 [87.5-95.0]	57.7 <sup>a</sup> [50.3-64.7]	58.1 [50.7-65.1]	0.01
Overweight stereotypes	72.5 <sup>a</sup> [68.0-76.6]	73.7 [69.2-77.7]	77.2 <sup>a</sup> [71.4-82.1]	75.4 [69.3-80.6]	66.0 <sup>a</sup> [58.7-72.6]	71.5 [64.4-77.7]	1.86
<b>Behaviour</b>							
Weekly SSBs (1+ in the last week)	50.4 <sup>a</sup> [45.6-55.2]	49.1 [44.3-53.9]	56.1 <sup>a</sup> [49.5-62.6]	47.9 <sup>‡</sup> [41.4-54.5]	42.3 <sup>a</sup> [35.3-49.6]	49.1 [41.8-56.4]	7.94*
Frequent SSBs (4+ in the last week)	21.9 <sup>a</sup> [18.2-26.2]	15.6 <sup>*</sup> [12.6-19.2]	23.1 <sup>a</sup> [18.0-29.2]	15.6 [11.7-20.3]	19.2 <sup>a</sup> [14.1-25.5]	14.7 [10.4-20.4]	0.35
Fruit: 2 or more serves a day	50.9 <sup>a</sup> [46.1-55.7]	52.1 [47.2-56.9]	50.2 <sup>a</sup> [43.6-56.8]	50.8 [44.2-57.3]	53.1 <sup>a</sup> [45.8-60.3]	54.2 [46.9-61.4]	0.01
Vegetables: 5 or more serves a day	10.7 <sup>a</sup> [8.3-13.8]	14.0 [11.0-17.6]	9.0 <sup>a</sup> [5.9-13.4]	11.9 [8.3-16.6]	13.1 <sup>a</sup> [9.3-18.2]	17.2 [12.4-23.4]	0.01
Sweet food: 3 or more times a week	53.4 <sup>a</sup> [48.6-58.2]	48.0 <sup>‡</sup> [42.5-53.5]	48.2 <sup>a</sup> [41.7-54.9]	41.7 [34.6-49.3]	59.6 <sup>a</sup> [52.2-66.6]	56.2 [47.6-64.4]	1.11
Fast food: 1 or more times a week	62.6 <sup>a</sup> [57.8-67.2]	66.4 [61.7-70.7]	62.5 <sup>a</sup> [55.7-68.8]	66.1 [59.4-72.1]	61.7 <sup>a</sup> [54.5-68.4]	65.8 [58.9-72.2]	0.02

Baseline characteristics: sex, age, weekly SSB consumption, SEP, BMI (except where included as an interaction term), parental status, commercial television viewing, and baseline levels of the outcome variable, were included as covariates in the models. Due to missing height and/or weight data, BMI could not be calculated for n = 17 respondents. Time 1 – May/June 2013, Time 2 – Aug/Sep 2013.

<sup>a</sup>Reference category. <sup>‡</sup>P < 0.05, \*P < 0.01, \*\*P < 0.001.

It is theorised that these observed changes in knowledge and behaviour with regard to sugary drink consumption are driven by the campaign simultaneously *motivating*, *reinforcing* and *enabling* adults to achieve health behaviour change.<sup>37</sup> As reported previously,<sup>18</sup> it is posited that individuals who perceive themselves to be susceptible will act to reduce their sugary drink consumption to the extent they are: *motivated* – determined by the personal perceived threat of not doing so (eg, disease, weight gain) and the extent to which the benefits of doing so are judged to outweigh the costs;<sup>38</sup> *enabled* – determined by the belief one has the skills and ability necessary to reduce their sugary drink consumption;<sup>39,40</sup> and *reinforced* – characterised by the extent to which results of reducing consumption are observable (eg, improved health, weight loss).<sup>41</sup>

These positive behaviour change findings extend the literature which to date has shown public health campaigns in the United States targeting SSB consumption not accompanied by complementary policy or regulatory change have demonstrated population-level impacts on message awareness and intentions to reduce consumption, but less so on more distal behaviour changes.<sup>11,12,16</sup> On the other hand, those that have run concurrently with healthy beverage policy implementation<sup>14</sup> or financial disincentives have demonstrated the greatest impacts on SSB consumption.<sup>13</sup> For the latter interventions, it is not possible to determine the unique contribution of the media component to effecting behaviour change. These positive behaviour change findings also suggest that campaign advertising was aired at sufficient intensity (average 190 weekly TARPs) to achieve change. Subsequent airing of the campaign in the Australian state of Victoria (average 120 weekly TARPs) also yielded impacts on reported SSB consumption.<sup>20</sup> Findings from the much more developed area of research on tobacco control mass media campaigns indicate that a TARPs level of at least 100 per week is necessary to promote behaviour change, with more favourable outcomes at higher doses.<sup>42</sup> It is important to confirm this in the area of obesity prevention, given consumers face a daily barrage of advertising to the contrary from industry.<sup>43</sup>

The study findings are limited by the relatively low follow-up rate, and differential loss to follow-up for some population groups has the potential to introduce bias. While questions were carefully ordered to avoid priming subsequent responses, participation in the baseline survey may have primed responses at follow-up. The study also relies on self-reported SSB consumption which is subject to social desirability bias. The timeline of the follow-up survey provides an indication of campaign impacts only in the short-term and does not assess whether these were maintained over the longer-term. Evaluation results from previous public health campaigns aimed at promoting nutrition or other self-protective behaviours show that while change can be achieved, it is difficult to maintain effects once campaigns end, particularly in the face of competing product advertising from commercial sources.<sup>27</sup> In the face of continuing product advertising for sugary drinks, it is likely that continued public health messaging discouraging sugary drink consumption will be necessary

if the changes that appear to have occurred in response to the present campaign are to be maintained or built upon. Further, the overweight stereotypes assessed provide an indication of the impact of the campaign on the social component of stigma but not of individual weight bias internalisation<sup>44</sup> and future evaluation of public education campaigns targeting weight-related behaviours should assess this dimension to provide a more comprehensive picture of their potential impact on stigmatisation of individuals with overweight or obesity. While the inclusion of a baseline sample prior to the launch of the campaign enhances the strength of the evidence, the lack of a control group and randomised allocation precludes the definitive attribution of effects to the campaign.

Despite these limitations, the evaluation provides some evidence the campaign was associated with increased awareness of the health consequences of drinking too many SSBs and some evidence of reduced intake of SSBs among adults with overweight or obesity and frequent consumers overall. The size of the behavioural effects reported here is in line with previous public health campaigns<sup>26</sup> and has the potential to contribute to prevention of obesity-related disease at the population level.

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## AUTHOR CONTRIBUTIONS

Morley was involved in conceptualising the study, analysing the data and writing the manuscript. Dixon was involved in reviewing the literature and reviewing and revising the manuscript. Wakefield was involved in conceptualising the study and reviewing and revising the manuscript. Niven was involved in data analysis and checking statistical assumptions. Swanson, Szybiak, Shilton, Pratt and Slevin developed and implemented the *LiveLighter* campaign and provided a critical review of the manuscript. All the authors read and approved the final manuscript.

## CONFLICT OF INTEREST

Three of the authors (Swanson, Szybiak and Shilton) are employees of the Heart Foundation (Western Australia) and two (Pratt and Slevin) are employees of Cancer Council Western Australia, who were involved in the development and implementation of the *LiveLighter* campaign. The other four authors (Morley, Niven, Dixon and Wakefield) have no competing interests to declare.

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